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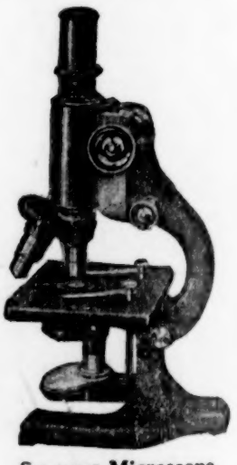

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THE CARNEGIE INSTITUTION OF WASHINGTON[1]

WHEN the armistice was agreed to by the contending nations in November, 1918, the Institution had become more of an agency for the promotion of warfare than one for the promotion of peaceful pursuits. About two thirds of the staffs connected directly with the Institution, or somewhat more than 200 men, were engaged in war work, and about the same proportion applies to the Research Associates of the Institution and their collaborators. Nearly every expert of the institution was able to render assistance and many of them devoted their entire time and energies to government work. Of the larger undertakings in this work, the most conspicuous are the development to the point of quantity production of the optical glass industry by the Geophysical Laboratory; the manufacture of precision micrometers for the U. S. Bureau of Standards and the manufacture of optical adjuncts for artillery by the staff of the Mount Wilson Observatory; the construction of special devices for the Navy in the shops of the Department of Terrestrial Magnetism; the contributions of the Nutrition Laboratory to knowledge of the effects of undernutrition; and the information service rendered by the Department of Historical Research. These undertakings required many men in arduous researches and involved no inconsiderable costs to the institution, since it assumed, in most cases, the principal overhead expenses. Not less important relatively than these larger operations were many special and individual contributions to the general cause. That essential occupations were quickly developed for what are sometimes called "narrow specialists" in nearly every branch of learning cultivated by

[1] From the report of the president, Dr. R. S. Woodward, for the year ending October 31, 1919.

the institution affords striking evidence at once of the diversity of modern warfare and of the ultimate practical value of recondite researches.

Although formal requests from the government for services ceased nominally toward the close of the calendar year 1918, they actually continued until nearly the middle of 1919. Thus, the optical work and the researches on the concentration of nitrates for the War Department did not end until June, 1919; the information work of the Department of Historical Research continued until mid-July; some special work for the Navy was done by the Department of Terrestrial Magnetism as late as September of this year; while a few other relations in government undertakings still remain to be served. It is only recently, also, that members of the institution in the military and other services of the government have returned to their posts; so that emergence from the untoward conditions in which we find ourselves has only fairly begun.

Naturally, this deflection of interest from the normal activities of the institution has led to many changes, to some dislocations, and to the suspension, or even abandonment, of a number of projects. The war, in fact, has brought some sinister consequences to the institution as well as to most other organizations. Fortunately, of those who entered the military and naval service only two lives were lost, namely, Karl Edward Anderson and Billings Theophilus Avery, both of the Department of Experimental Evolution, who died during the year 1918. Fortunately, likewise, while some members of the investigatory staffs of the departments of research have been drawn off, by reason of their abilities, into industrial or other occupations, the number of such is not only small but not in excess of an inevitable and healthy exchange between a progressive establishment and its contemporaries.

Detailed reports concerning the war activities of the institution, and particularly concerning the work done by the departments of research, are on file in the office of administration; so that if it should become necessary to publish an account of these activities the essential data are at hand. The time for publication of such an account does not appear to have arrived, since the government is entitled to initiative and priority in all these matters.[2] Hence only the briefest references to them are made in this and other parts of the current Year Book.

It should go without saying that the disturbed conditions, social, industrial, economic and governmental, under which the world is now laboring are not without untoward effects on the institution. Being a part of and not apart from contemporary life, it must share to a greater or less extent in the consequences which follow from an unparalleled attempt at national supremacy based on the desperate doctrine of "dominance or downfall." But obvious as these consequences are in the abstract, there appear to be many outside and some within the institution who think that it may continue to expand regardless of the limits of its income and regardless of the fact that the purchasing capacity of this income has diminished by one half during the past decade. In line with these vagaries there is a recrudescence also of the juvenile notion so commonly held of the institution in its earlier years, that it may play the rôle of paternalism for other establishments and for individuals, and that it may act generally as a salvager in the wreckage of the world. Similarly, just as in political affairs it is often assumed that the prevailing scarcity of necessities and the burdens of taxation may be relieved by other means than by productive labor, so it is assumed that the institution may meet the increasing costs of its operations, not by appropriate restrictions and economies, but by increasing appropriations drawn from mythical sources. Thus the distribution of necessary disappointment, which has been so large a part of the unproductive business of the administrative office hitherto, is now increasing, stimulated by two generations of men unaccustomed to the practise of

[2] A concise history of the production of optical glass is given by Dr. Fred E. Wright (major, Engineer Corps, U. S. A.), of the staff of the Geophysical Laboratory, in "America's Munitions," published by the War Department in 1919.

thrift and justified by the widely prevalent but immoral theory that the institution may proceed "regardless of expense."

THE HOOKER TELESCOPE

One of the distinct, if relatively unimportant, misfortunes of the world war was the delay in testing the capacities of the 100-inch telescope named after Mr. John D. Hooker, of Los Angeles, who made the initial contribution toward the construction of this instrument thirteen years ago. It was substantially completed shortly before the United States became a participant in the conflict. About this time, also, the director of the Observatory became chairman of the National Research Council and he continued to give all his time to this governmental organization until May of this year. In the meantime, likewise, as already indicated, the staff of the observatory was preoccupied largely with military rather than with astronomical affairs. Hence, opportunity has only recently arrived for determination of the critical question whether this "largest telescope," which is 28 inches larger than its largest predecessor, and 40 inches larger than the highly successful 60-inch instrument completed by the observatory in 1908, would meet expectations in optical capacity and practicability of operation. The construction of so large a telescope has been regarded as one of the hazardous undertakings of the institution. Its optical perfection depends on the stability of the glass used for its mirror; the stability of the latter depends in turn on the rigidity of its mountings; the requisites in both cases must take into account the elastic mobility of materials and the disturbing effects on them of temperature changes; and all these considerations must unite to secure a combination which is manageable. The problems in engineering thus presented have appealed very strongly to all parties interested in such constructions, perhaps almost as strongly as the astronomical possibilities anticipated from such an extensive addition to visual apparatus. But the director of the observatory now reports that the optical and the engineering difficulties have been overcome and that the instrument under repeated tests has proved efficient quite beyond the conservative theoretical predictions of attainable capacities.

THE NON-MAGNETIC SHIP

As related in the report of the preceding year, it was deemed expedient, in April, 1917, on account of dangers to navigation, to suspend the cruise contemplated by the Department of Terrestrial Magnetism for additional surveys in the Atlantic Ocean by the ship *Carnegie*. As related also in that report, this ship was brought safely, by way of the Pacific Ocean and the Panama Canal, to the port of Washington, District of Columbia, arriving there June 10, 1918. She lay here until the spring of 1919, when it was decided to send her out again on her mission as soon as necessary repairs and alterations could be made. Of the alterations required, the most important was the adaptation of her engine for auxiliary propulsion to the use of gasolene as fuel. When the ship was launched, in 1909, it was easier to get anthracite coal than gasolene or other liquid fuel in remote parts of the world. Hence the engine was constructed to use gas derived from such coal by the so-called producer process. In the meantime, anthracite coal has become much less and gasolene much more accessible at distant seaports, and this circumstance has led to the noteworthy, and in these times expensive, but highly advantageous change here specially referred to. After delays which serve to emphasize the inefficiency of mankind under post-war conditions, on October 19, the *Carnegie*, under the command of Mr. J. P. Ault, put to sea from the Virginia Capes, on her sixth cruise, to comprise surveys in the Atlantic and Indian Oceans not yet adequately covered by previous circuits.

PUBLICATIONS OF THE YEAR

Of all branches of the institution the one least affected by the war is the Division of Publications. Although it has undergone some changes in staff and encountered the obstacles due to a rapid rise in the costs of printing and illustrations, its work has gone

on without serious interruption; and the output of books for the year, as may be seen by reference to the detailed list given in a later section of this report, is rather greater than the average annual output for the past decade. Of the entire list of twenty-nine volumes issued, only two classes of them, selected mainly for the purpose of showing trends of progress, may be referred to here.

The most elementary, the most essential, and hence the most widely used, if not esteemed, of the sciences is arithmetic. It is a fundamental requisite, in fact, of all exact knowledge. Ability to add, subtract, multiply, and divide affords probably the simplest test of capacity for correct thinking. Conversely, inability or indisposition to make use of these simple operations affords one of the surest tests of mental deficiency, as witnessed, for example, by numerous correspondents who are unable to or who refuse to apply these operations to the finances of the institution. But the familiar science of arithmetic lies at the foundation also of a much larger and a far more complex structure called the theory of numbers. This theory has been cultivated by many of the most acute thinkers of ancient and modern times. It has more points of contact with quantitative knowledge in general than any other theory except the theory of the differential and integral calculus. These two theories are complementary, the first dealing with discrete or discontinuous numbers and the second with fluent or continuous numbers. Naturally, a subject which has attracted the attention of nearly all of the great mathematicians of the past twenty centuries has accumulated a considerable history. The more elementary contributions of Euclid, Diophantus, and others of the Greek school; the extensions of Fermat, Pascal, Euler, Newton, Bernoulli and many others in the seventeenth and the eighteenth centuries; and the work of Lagrange, Laplace, Gauss, and their numerous contemporaries and successors of the nineteenth century, make up an aggregate which has stood hitherto in need of clear chronological tabulation and exposition. This laborious task was undertaken about ten years ago by a Research Association of the Institution, Professor Leonard E. Dickson, of the University of Chicago. A publication under the title "History of the Theory of Numbers" has resulted, and Volume I. (8vo, xii + 486 pp.), devoted to divisibility and to primality of numbers, has appeared during the past year; and a second volume devoted to diophantine analysis is now in press. This work is remarkable for its condensation of statement. It contains more information per unit area than any other work issued thus far by the institution. It is remarkable also for the care taken by the author and by his collaborators to secure precision and correctness, a number of experts having assisted in the arduous labors of verification required during the process of printing.

It is the object of science primarily to find answers to the question "How?" rather than to the question "Why?"; or, to seek to describe phenomena rather than to try to explain them. Words, however, constitute, in general, a rather imperfect medium for the communication of ideas, and as a consequence the intellectual world, like the political world, often finds itself involved in misunderstandings which lead to nothing better than that metaphorical and degenerate form of energy called the heat of controversy. Thus, about a half-century ago there arose, as we now see, a quite needlessly bitter discussion over the question whether and to what extent the phenomena of life may be traced back to the properties of matter with which they are obviously intimately associated. The new science of biology was just then arising and the limitations of its domain and the conditions of its existence and development were widely disputed, as is best shown probably by the lay sermon of Huxley delivered at Edinburgh November 8, 1868, "On the Physical Basis of Life." In this remarkable address Huxley defines, with prophetic clearness and completeness, the limitations and the conditions in question and these, as he defined them, are now generally admitted as essential to all fruitful inquiry. Moreover, the principles expounded by Huxley have been justified in amplest measure by the extraordinary

progress since accomplished, not only in biology, but in all the physical sciences.

It is good fortune for a research establishment to have been founded during the course of this progress and to be able to take part in it; and although the publications of the institution are not restricted to any domain of learning, a considerable number of them bear directly or indirectly on this profoundly interesting and increasingly important problem of "the physical basis of life." The past year has been unusually productive in this line, for no less than a dozen volumes have been added to the institution's series of contributions to evolution, heredity, and the application of thermodynamics to the interpretation of metabolism in man. These contributions are particularly noteworthy also for the extent to which cooperation has been required, since more than twenty authors and more than twice that number of collaborators are represented in the dozen volumes referred to.

THE SIGNIFICANCE OF THE DECLINING BIRTH-RATE —A REPLY[1]

MEMBERS of Section I in attendance at the meeting last year will recall the address of the retiring vice-president and chairman of the section. This meeting offers a suitable opportunity to present at least one of the replies which such an address might be expected to call forth.

Seventy per cent. of Mr. Dublin's paper was occupied with statistics, and these we may accept as coming from an expert statistician. It is the remaining thirty per cent.—embodying the author's view of the *significance* of the declining birth-rate—that invites attention.

To begin with, I hardly need point out the necessity of recognizing the prevalence of multiple and compound causes in all fields of social phenomena. When a compound cause has been disentangled from a mass of observations its individual factors must be carefully weighted in order to give proper prominence to the chief one. Mr. Dublin arraigns the women and their education for the declining birth-rate. In so doing he involves himself in a significant concession; and one wonders how, with so much of a clue, he has failed to perceive the true interpretation of the social feature which he deplores. He has fixed his attention on very minor and limited causes only to lose sight of the great generic cause.

For we are to-day in the midst of a revolution quite unparalleled in the history of the human race—whether it be viewed as regards the number of persons concerned, or the length of its preparatory prelude, or the importance of the consequences which will undoubtedly follow it. I refer to the movement connected with the discovery that women, in spite of being females, are primarily human beings, with the same desires for freedom and self-direction, the same ranges in tastes and abilities and ambitions, that men have. This discovery is due to woman's recently acquired opportunity for knowledge and opportunity for economic self-dependence. These opportunities themselves seem to be involved first as effects and then as causes in modern human progress. The evolution of society—civilization itself—had proceeded as far as it could, with the archaic status of woman unmodified.

Folklore and literature from earliest times to very recent days have been charged with positive expressions of the place and duty of the female. Radical writers and conservative ones alike, teachers, philosophers, statesmen and poets, have—with few exceptions—been agreed that that place was home and that duty the care of the home and the rearing of children. Very naturally all schemes of government and all systems of theology have been in harmony with this popular conviction. To cook a thousand meals a year, to make beds and wash dishes a thousand times a year, to bear children—always to bear children—in meekness and resignation, has been held to be the woman's lot as ordered by Providence or at least by Nature. What else could a normal woman want to do?

[1] Read before Section I (Social and Economic Science) of the American Association for the Advancement of Science, Baltimore, December 27, 1918.

If reiteration could save a doctrine or confer the attribute of truth this doctrine would not now be moving to join its companion superstitions: Special Creation and the Fall of Man. The savage with his savage job of hunting and fighting made the inferences that might be expected from a primitive mind regarding the creature who staid at home to cook his food and care for his child: one who could not—or at least did not—fight was inferior. The reasoning of post-savage and post-barbarous peoples is an extraordinary mass of testimony to the slowness with which the human mind has advanced to scientific aptitude. Philosophers, theologians and statesmen—no less than common persons—have failed to perceive that *no conclusions based on observations of unfree human subjects can safely be drawn regarding what is normal in those subjects.* Failure to recognize this principle accounts for the surprise, the dismay and the disapproval upon witnessing among free woman what is apparently most unnormal behavior; that is, behavior inconsistent with the normal or type-form as it had been understood.

In the United States, as late as 1850, women—being without other means of securing food, clothing and shelter—married on terms not of their own making. They bore children according to the pleasure of those whom they were to obey and in recognition of a dogma of theology which they were taught to hold as divinely endorsed. For, lacking knowledge, women were no more free in mind than they were in body lacking economic independence. This type of woman has practically disappeared below the historical horizon—succeeded by a multitude of women of affairs, in gainful occupations, in the activities of business, philanthropy, education, professions and in concerns that require the highest order of organizing and administrative ability—women who offer no apology for their choices and no defense of their activities.

Now, the most noticeable consequence of the new freedom is that each woman is deciding for herself whether she will marry or not. And in case she does marry, the deciding vote as to the number of children to follow is likely to rest with her. The woman of to-day will herself determine what her duty is in the case. We may reason with our equals or appeal to them; but for one person to tell another grown-up person his duty, or for one class of persons to dictate the duties of another class, seems now to be unsustained by ethical courtesy. Justice has reached the point of insisting that as regards bearing many or any children a woman must be free to decide—free from the coercion of government, or religion, or public opinion, or a disordered conscience.

That "revolution" is not too strong a word to mark what has taken place in two incomplete decades of the twentieth century is well indicated by comparing the war-time position of women in the past with that of the present. The lady of the nineteenth century and all preceding ones waited and wept at home and prayed for her lord's safe return from the wars. To-day history takes into her keeping the story of the multiple *Entente* of women who helped to win the Great War. The sudden need that women should come out of the home and lend a hand in a hundred ways has led to an unexpected and perhaps unwelcome proof of what they will usually do as free persons. No doubt there are those who find consolation in the thought that women's war activities have been a spasmodic though commendable expression of patriotism, a temporary estrangement from their true work and, the war over, they will return to their "normal" place: the home. It may readily be admitted that the new freedom is too new to permit of immediate conclusions. Sociology no less than geology or physiology or any other science requires us to suspend judgment. All that can be asked on the one hand, all that need be granted on the other, is that in the great laboratory which we call human society the class investigated, the women, shall be free. A provisional judgment is that while many women will probably prefer to devote themselves to domestic activities, many others will be equally inclined—and resolved—to occupy themselves with the varied pursuits which have hitherto

been claimed by men alone. The statistics of the Census of 1920 will contribute much to the discussion. Meanwhile it must be disconcerting to reactionary persons to observe how many young women are disposed to do the very thing for which young men are commended; namely, to select a line of work and carry it through to success.

But the declining birth-rate. If n is the number of births per thousand per year and n' the number of deaths per thousand per year of children, say under one year of age, $n-n'$ is the effective birth-rate. Obviously this can be raised by increasing n or by diminishing n'. To increase n has been the way of barbarism. "What if the children do die; the woman can bear plenty more." This is not the sentiment of some distant past age; for, as Francis Galton remarks, men were barbarous but yesterday.

The method of the new civilization is to decrease n'. Up to last July (1918) the Federal Children's Bureau had weighed and measured approximately six million children under six years of age. A large number were were found to be undernourished; many others were victims of diseases easily remedied by proper medical attention. Under the auspices of this bureau nation-wide plans are developing to provide public health nurses, better hospital care and the conservation of milk for children. It appears also that really effective means for saving the young children involves care of the mother not only after the child's birth but also months before.

"Save 100,000 of the 300,000 children that now die annually under one year of age!" is not the slogan of a few sentimental philanthropists; it is the purpose of the national government. This federal bureau further reports that 15,000 women die annually in the United States from childbirth; and it declares that of this total most of the deaths are preventable because due to ignorance and improper care. Nothing in this world has been so cheap as child-life except mother-life.

But I now squarely challenge Mr. Dublin's fundamental assumption that a declining birth-rate is an evil. What reason does he give, what reason has anybody given, why the hither and the uttermost parts of North America say, should forthwith be populated as rapidly and as densely as may be—even by elect stock. Why should the natural forests be so hurriedly worked into lumber and the country's non-restorable natural resources—coal, petroleum, gas and others—be exploited to the exhaustion point? Has the United States any grounds for felicitating herself on the fact that she is burning coal at the rate of 600,000,000 tons per year? And how many years may she expect to continue such self-felicitations? It is the crudest form of collective selfishness for any one generation to act as if it had a final lien on the earth when at best it is only a temporary tenant, in honor bound by the highest racial ethics to consider the interests of those who follow: the peoples of distant centuries. This generation more than any which has preceded it seems bent on bequeathing an impoverished domain to its "heirs and assigns forever." "Few men really care what happens to posterity."

Your vice-chairman's protest against any decrease in the birth-rate meets rebuke also in the condition of the congested points where most of the increase in population is to find its home: the city. Are the city's streets—all of her streets—clean and attractive? Are her homes—all of her homes—sunny and sanitary? At what age do her children leave the public schools, and why do they leave? What are the hours and wages of young women in her laundries, candy-shops, stores, restaurants and factories? Are her women citizens no longer discriminated against as political outlaws? Has the city figured out a minimum of subsistence, of health, of education, of leisure, for all of her citizens? Until these questions are satisfactorily answered the "socially and economically efficient class" may well address itself to the practical task of bettering the conditions of human living rather than to an effort to state the population of the city in six figures instead of five.

Mr. Dublin's theory that the country will be saved if the afore-mentioned "socially and economically efficient" will only marry and raise large families runs counter to facts, for facts show that permanent betterment can

not be achieved by so simple a device as quantitative displacement. Indeed, society has always paid a price of defeat when it has attempted to nurture, through mere descent, a so-called better class superposed on a class of alleged inefficients. A group, *a*, socially and economically efficient has no guaranty that an offspring group, *a'*, will be likewise superior. What is "good blood" anyhow? It is that blood which manifests the skill and purpose to behave uprightly as a member of civilized society. But behavior can not be calculated in advance like the ephemeris of a comet. It lies outside the realm of any law of heredity as yet disclosed; for in the sequel the first of blood are apt to be last and the last first.

Mr. Dublin's contrast of native-born stock with foreign-born to the disadvantage of the latter is especially unjustified by facts. The most "native" of us are not so very native that we can with any propriety look with disdain on the great numbers of devoted and able citizens of the United States who happen to have been born on the east side of the Atlantic.

It is too late now to evade the business of defining "democracy." The Reconstruction Program of the British Labor Party—probably the most important document which world conditions have brought into existence during the past five years—starts us on the way to a definition by reciting that "the first condition of democracy is effective personal freedom." "Effective personal freedom" is a mocking phrase unless it means freedom to choose one's work, to choose one's forms of service, and to live one's life not hindering others and not hindered by others. Whatever it costs of traditions and prejudices and theories democracy requires now that there be no subject race, no subject class and no subject sex. Mr. Dublin does not seem to grasp this idea. He appeals to government, to religion, and to the schools, to return woman to what he believes to be her sphere. But governments, religions and schools do not originate or lead world movements; they follow and if they are wise they accept the inevitable. The movement briefly denoted by the phrase, "freedom of women," is here because its time had come. Constitutions of governments, creeds of religions, curriculums of schools, are adjusting themselves to its requirements.

A study of the folk-customs of savage tribes has brought to light a system of tabu which amounts to strangerhood between men and women in all relations except the sex relation. The new society, the Great State, will show strangerhood replaced by comradeship. Men and women will together own the earth and together administer human affairs —all human affairs. It is plainly so written on the scroll which evolution unrolls.

Ellen Hayes

Wellesley, Mass.

SCIENTIFIC SOCIETIES MEETING AT ST. LOUIS

The following societies have indicated their intention to meet in St. Louis during Convocation Week in affiliation with the American Association for the Advancement of Science:

Mathematical Association of America.—(Missouri Section.) December 29. President, H. E. Slaught; Secretary, Professor Paul R. Rider, Washington University, St. Louis, Mo.

American Mathematical Society.—(Chicago and Southwestern Sections.) December 30 and 31. Joint session with Section A on December 30. Acting Secretary, Dr. Arnold Dresden, 2114 Vilas St., Madison, Wis.

American Federation of Teachers of the Mathematical and the Natural Sciences.—Secretary, Dr. William A. Hedrick, Central High School, Washington, D. C.

American Meteorological Society. December 29 to 31; joint meetings with Sections B and E on dates to be announced. Secretary, Dr. Charles F. Brooks, U. S. Weather Bureau, Washington, D. C.

American Physical Society.—December 30 to January 1, in joint session with Section B, President, J. S. Ames. Secretary, Dr. Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio.

Society for the Promotion of Engineering Edution.—President, Arthur M. Greene, Jr. Secretary, Professor Frederic L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

Optical Society of America.—January 2. Presi-

dent, F. E. Wright. Secretary, Dr. P. G. Nutting, Westinghouse Research Laboratory, East Pittsburgh, Pa.

Association of American Geographers.—December 30 to January 1. President and Acting Secretary, Dr. Charles R. Dryer, Oak Knoll, Fort Wayne, Ind.

National Council of Geography Teachers.—December 29 and 30. President, Albert P. Brigham. Secretary, Professor George J. Miller, State Normal School, Mankato, Minn.

American Society of Zoologists.—December 29 to 31, in joint session with Section F. Joint session with Ecological Society of America on Tuesday afternoon, December 30. Zoologists' dinner, with address of Vice-president of Section F and moving picture films of Barbadoes-Antigua Expedition by C. C. Nutting, on Wednesday night, December 31. President, C. M. Child. Secretary, Dr. W. C. Allee, Lake Forest College, Lake Forest, Ill.

Entomological Society of America.—December 29 and 30. President, J. G. Needham. Secretary, Dr. J. M. Aldrich, U. S. National Museum, Washington, D. C.

American Association of Economic Entomologists.—December 31 to January 2. President, W. C. O'Kane. Secretary, Albert F. Burgess, Gipsy Moth Parasite Laboratory, Melrose Highlands, Mass.

Botanical Society of America.—December 30 to January 1, with joint sessions as follows: Tuesday, December 30, Section G; Wednesday, December 31, American Society for Horticultural Science; Thursday, January 1, 10 A.M., Ecological Society of America, 2 P.M., American Phytopathological Society. On Wednesday night, December 31, will be the annual dinner for all botanists, followed by presidential address. President, J. C. Arthur. Secretary, Professor J. R. Schramm, N. Y. State College of Agriculture, Ithaca, N. Y.

American Phytopathological Society.—President, C. L. Shear. Secretary, Dr. G. R. Lyman, U. S. Department of Agriculture, Washington, D. C.

American Society for Horticultural Science.—December 29 to 31. President, J. W. Crow. Secretary, Professor C. P. Close, College Park, Md.

Association of Official Seed Analysts.—Will meet on Monday and Tuesday, December 29 and 30. President, H. D. Hughes. Secretary, R. C. Dahlberg, University Farm, St. Paul, Minn.

Ecological Society of America.—December 30 to January 1, with joint session with the American Society of Zoologists on Tuesday, December 30, and with Botanical Society of America on Thursday, January 1. President, Barrington Moore. Secretary, Dr. Forrest Shreve, Desert Botanical Laboratory, Tucson, Arizona.

American Pomological Society.—December 30 to January 1. President, L. H. Bailey. Secretary, Professor Edward R. Lake, Hotel St. Nicholas, Albany, Ga.

American Microscopical Society.—December 30, for luncheon and executive committee and on Wednesday, December 31, for business meeting just following Section F afternoon session. President, L. E. Griffin. Secretary, Professor Paul S. Welch, University of Michigan, Ann Arbor, Mich.

American Nature-Study Society.—December 30. President, L. H. Bailey. Secretary, Dr. Anna Botsford Comstock, Cornell University, Ithaca, N. Y.

Wilson Ornithological Club.—December 29 and 30. President, Myron H. Swenk. Secretary, Professor Albert F. Gainer, 924 Broadway, Nashville, Tenn.

American Metric Association.—December 29 and 30. President, George F. Kunz. Secretary, Howard Richards, Jr., 156 5th Avenue, New York, N. Y.

Society for the Promotion of Agricultural Science.—Secretary, Dr. C. P. Gillette, Colorado Agricultural College, Fort Collins, Colo.

Society of Sigma Xi.—President, Julius Stieglitz. Secretary, Dr. Henry Baldwin Ward, University of Illinois, Urbana, Ill.

Gamma Alpha Graduate Scientific Fraternity.—President, Norman E. Gilbert. Secretary, Dr. Albert H. Wright, Cornell University, Ithaca, N. Y.

Phi Kappa Phi.—December 31. President, Edwin E. Sparks. Secretary, Dr. L. H. Pammel, Iowa State College, Ames, Iowa.

Gamma Sigma Delta.—Thursday, January 1. President, C. H. Eckles. Secretary, Dr. L. H. Pammel, Iowa State College, Ames, Iowa.

SCIENTIFIC EVENTS

SCIENCE AND INDUSTRY IN NEW ZEALAND

THE Industries Committee of the New Zealand House of Representatives has made the following recommendations for the creation of a Board of Science and Industry:

1. That a Board of Science and Industry be established for the development of national resources.

2. That the board be given an assured finance

for five years; it is recommended that it should receive not less than £5,000 for the first year and £20,000 for each of the four following years.

3. That the board shall be representative of the various sections of science and industry.

4. That the board shall, as one of its chief functions, consider all proposals for specific scientific researches, and shall allot to the proper person or persons the duty of conducting such specific researches as it may approve.

5. That in order to avoid centralization, and in the interest of economy, the board, in the carrying out of investigations, shall wherever possible cooperate with the university, college authorities in the various centers, with a view to making the fullest possible use of their staffs and laboratories; there shall also be set up local advisory boards to inquire into, advise and report upon local problems.

6. That one of the duties of the board shall be to advise primary producers, and those engaged in industrial pursuits, as to the results of scientific investigations affecting or calculated to benefit their industries, including processes for the utilization of waste products.

7. That the board shall have power to establish scholarships and also to award bonuses and prizes, with the object of encouraging scientific and industrial research.

8. That the board shall keep touch with government departments and also with scientific and educational institutions, with a view to cooperation in scientific investigation as well as in furtherance of scientific education and of everything which will tend to foster a greater appreciation of the advantages of science, not only by producers, but by the people at large.

RESEARCH IN THE CERAMIC INDUSTRY

The National Research Council and the American Ceramic Society have established a joint committee for promoting the investigation of scientific problems underlying the ceramic industry, especially by founding a series of research fellowships whose holders shall devote their attention exclusively to these problems. A press statement from the council says:

The ceramic industries, including brick and tile making, and general crockery and glass manufacture as well as ornamental potteries, although among the earliest ones developed by man, have been the last of our great manufacturing industries to reach the status of an applied science. They have been based for centuries on rule-of-thumb methods, trade secrets and individual artistry. As far as their artistic features go science can do little or nothing for them, but in all other ways it can be of great advantage to them.

In sharp contrast to the painfully slow development of these ancient industries is the extraordinarily swift development of such exclusively modern industries as those of synthetic dyes and others entirely based on the discoveries of modern science. The startling success and speed of growth of these are almost entirely the fruit of highly organized scientific research, with methods of scientific control at young stages of the operations. A famous English scientist is authority for the statement that the capital, large as it has been, which the German dye firms have invested in scientific research has been the best-paying investment which the world has ever seen. It is certain that an organized effort to develop the fundamental science of ceramics can have a great influence in advancing the industry.

AWARDS BY THE HENRY DRAPER COMMITTEE OF THE NATIONAL ACADEMY OF SCIENCES

In accordance with the recommendations of the Henry Draper Committee, the following grants and award of medals have been made by the National Academy:

1. $400 to Dr. S. A. Mitchell, director of the Leander McCormick Observatory, University of Virginia, to complete the purchase of a measuring microscope for use in the photographic determination of stellar parallaxes, on the basis of observations made with the 27-inch refracting telescope. The academy awarded the sum of $250 from the Draper Fund to Dr. Mitchell in 1916 to apply on the purchase of this instrument. The microscope cost $650. The proposed grant of $400 will complete the purchase, in effect making the instrument the property of the academy, and Professor Mitchell will devote an equivalent sum, $400, to the other needs of his parallax research.

2. $300 to Dr. Joel Stebbins, professor of astronomy in the University of Illinois, to assist in the further development and application of the photo-electric cell photometer.

3. $400 to Dr. Frank Schlesinger, director of the Allegheny Observatory, to enable him to test an automatic zenith camera for the determination of terrestrial latitudes with the expectation that the results will be more accurate than any hitherto

obtained by other means. It is proposed that this instrument be mounted at least temporarily at the International Latitude Observatory, Ukiah, California, where the astronomer in charge, Mr. Neubauer, will operate it for a year or two as a labor of love. The grant is needed to install the instrument at Ukiah and to make certain auxiliary apparatus required in its operation.

The Henry Draper Gold Medal has been awarded to Alfred Fowler, F.R.S., professor of astrophysics, Imperial College, South Kensington, London, at the time of the stated meeting in April, 1920, for his researches in celestial and laboratory spectroscopy, which have led to a valuable increase of our knowledge of sunspots, comets and the stars—especially red stars of Secchi's Type III.

ADDRESSES AT THE ST. LOUIS MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

As has been noted here the American Association will hold its seventy-second meeting in St. Louis from December 29 to January 3, under the auspices of the educational institutions of that city. With the period of reconstruction now at hand, and with a larger measure than ever before of general appreciation of the extreme importance and value to the country of scientific research, it is expected that this meeting will be one of unusual interest. The address of the retiring President of the Association, Dr. John Merle Coulter, of the University of Chicago, will be on "The Evolution of Botanical Research" and will be delivered at the opening General Session on Monday night, December 29. The addresses of the retiring vice-presidents of the sections, to be delivered throughout the week, are as follows:

Section A.—George D. Birkhoff. "Recent advances in dynamics."

Section B.—Gordon F. Hull. "Some aspects of physics in war and peace."

Section C.—Alexander Smith. "Chemistry as it is taught."

Section D.—Ira N. Hollis. "Industrial problems of the United States."

Section E.—David White. "Geology as taught in the United States."

Section F.—William Patten. "The message of the biologist."

Section G.—Albert F. Blakeslee. "Sexuality in the mucors."

Section H.—Aleš Hrdlička. "The relations of psychology and anthropology."

Section I.—John Barrett. "New after-the-war phases of practical Pan-Americanism."

Section K.—F. S. Lee. "The untilled fields of public health."

Section L.—Stuart A. Courtis. "The part played by heredity and maturity as factors conditioning the effects of training."

Section M.—Henry P. Armsby. "The organization of research."

On Tuesday night, December 30, Dr. Simon Flexner, president of the association, will deliver a popular lecture, complimentary to the members of the association and affiliated societies and to the general public.

MR. FRICK'S BEQUESTS

WITH the exception of approximately $25,000,000 bequeathed to his family, relatives, friends and employees, the will of Henry C. Frick leaves his estate, believed to be worth approximately $145,000,000, for public, charitable and educational purposes.

Mr. Frick's house and art collection in New York city, which after the termination of Mrs. Frick's life estate are to go to the public, are valued at approximately $50,000,000. An endowment of $15,000,000 is provided to maintain this as "The Frick Collection."

Pittsburgh, where much of Mr. Frick's wealth was acquired, receives a tract of about 151 acres of land in the 14th ward of that city for a park and $2,000,000 in trust to maintain and improve the property.

The residuary estate to be divided into 100 shares valued at about $500,000 each, is left to nineteen institutions.

Princeton University recieves thirty of these shares, or about $15,000,000.

Harvard receives ten shares, or about $5,000,000.

The Massachusetts Institute of Technology receives ten shares, or about $5,000,000.

Educational Fund Commission Pittsburgh, ten shares or about $5,000,000.

Mercy Hospital, Pittsburgh, ten shares, or about $5,000,000.

Thirteen shares are given to Mr Frick's

daughter, Helen, "in unqualified and absolute ownership," but with this suggestion: "It would, nevertheless, be agreeable to me that she should dispose of these amounts, that my general purpose in making these legacies should be accomplished, but this is merely the expression of my wish."

Institutions receiving one share or about $500,000 each are as follows:

Pittsburgh Free Dispensary, Pittsburgh, one share.

Pittsburgh Newsboys' Home, one share.

Western Pennsylvania Hospital, Pittsburgh, one share.

Central Young Women's Christian Association, Pittsburgh, one share.

Uniontown Hospital, in Fayette county, Pa., one share.

Cottage State Hospital, in Connellsville, Pa., one share.

Westmoreland Hospital, in Greensburg, Pa., one share.

Mount Pleasant Memorial Hospital, of Mount Pleasant, Westmoreland County, Pa., one share.

Braddock General Hospital, of Allegheny county, Pa., one share.

Homestead Hospital, of Homestead, Pa., one share.

Children's Hospital, Pittsburgh, One share.

Allegheny General Hospital, Pittsburgh, one share.

Home for the Friendless, Pittsburgh, one share.

Kingsley Home Association, Pittsburgh, one share.

SCIENTIFIC NOTES AND NEWS

Dr. Richard M. Pearce, professor of research medicine in the University of Pennsylvania under the John Herr Musser Foundation, has accepted the position of director of the newly established division of medical education of the Rockefeller Foundation. Dr. Pearce has sailed for Europe to carry out work in the interest of the foundation.

Dr. E. A. Peterson, of Cleveland, Ohio, has been appointed director of the health service department recently created by the American Red Cross to administer its peace-time activities in the health field. Dr. Peterson served during 1918–1919 as major with the American Red Cross commission on tuberculosis to Italy and had charge of the department of school hygiene. For the previous eight years he had been the director of the Department of School Health in Cleveland, Ohio. He has taken up the work and is located at National Headquarters, American Red Cross, Washington, D. C.

Dr P. G. Acnew has resigned as physicist at the Bureau of Standards to become secretary of the American Engineering Standards Committee, with headquarters in the Engineering Building, 29 West 29th Street, New York.

The National Academy of Sciences has awarded its medal for eminence in the application of science to the public welfare to Mr. Herbert C. Hoover for his applications of science in the conservation, selection and distribution of food. The medal will be conferred at the April meeting of the academy.

William Orpen, will paint a presentation portrait of Sir Clifford Allbutt, president of the British Medical Association, and a mezzotint engraving of the portrait will be executed by Mr. H. Macbeth-Reaburn.

The annual address of the Entomological Society of America, at its St. Louis meeting, will be given by Dr. J. W. Holland, director of the Carnegie Institute, on the evening of December 30, the subject being "The evolution of entomological science in North America."

Professor T. L. Hankinson, of the Eastern Illinois State Normal School, has accepted the position of ichthyologist at the Roosevelt Wild Life Forest Experiment Station, at the New York State College of Forestry at Syracuse. This station was established last May by the legislature of New York as a Wild Life Memorial to Theodore Roosevelt. Professor Hankinson will begin his duties at Syracuse on January 1. During the past five summers he has been working for the college on state fish surveys, in cooperation with Dr. Charles C.

Adams, director of the station, on Oneida Lake, and in the Palisades Interstate Park. The surveys, which in the past have been conducted by the department of forest zoology, have been taken over by the Roosevelt Wild Life Station and will be conducted in the main under its auspices.

DR. MABEL L. ROE, who resigned in July as assistant plant pathologist in the Kentucky Agricultural Experiment Station, has recently accepted an appointment as seed analyst in the Dickinson Seed Company, Chicago.

MR. F. W. GLADING, of the Bureau of Standards, has resigned to become industrial engineer for the Baldwin Locomotive Works, at Philadelphia, Pennsylvania.

THE annual dinner of the New York Academy of Sciences and its affiliated societies will be held at seven in the evening, Monday, December 15, 1919, at the Delta Kappa Epsilon Club, 30 West 44th Street. The dinner will be followed by the annual meeting of the academy, to receive reports and elect officers and fellows for 1920. The presidential address will be delivered by Dr. Ernest Ellsworth Smith, on "Applied science and the war." After the president's address there will be given two illustrated talks, as follows: Professor Douglas W. Johnson, on "A geographer at the front and at the Peace Conference," and Professor Henry E. Crampton, on "Tahiti and the South Seas."

AT a meeting held on November 25 in the main auditorium of the New National Museum, Washington, D. C., Professor Irving Fisher, of Yale University, addressed members of the Scientific-Technical Section of the Federal Employees Union and their friends on "The purchasing power of salaries." Professor Fisher elaborated his theory of a stabilized dollar, claiming that an invariable unit of value is of even greater importance than invariable units of other quantities, such as length, weight, etc. The section voted to appoint a committee for a study of the proposal with instructions to report back a resolution granting or withholding endorsement according to the findings of the committee.

IT is announced that unavoidable circumstances necessitate a change in the meeting place of The Federation of American Societies for Experimental Biology. The meeting will be held at Cincinnati, Ohio, December 29, 30 and 31, instead of at Toronto.

MRS. MARY CLARK THOMPSON has presented to the National Academy of Sciences a fund amounting to $10,000, the income of which is to be applied to a gold medal of appropriate design, to be awarded annually by the academy for the most important services to geology and paleontology. The medal is to be known as the Mary Clark Thompson Gold Medal. Mrs. Thompson previously gave an additional $1,000 for the preliminary expenses of dies.

A UNITED STATES Civil Service examination for superintendent in the Bureau of Fisheries will be held on December 30, 1919. A vacancy at the Key West, Florida, Biological Station of the Bureau of Fisheries, at $1,800 a year and vacancies in positions requiring similar qualifications, will be filled from this examination.

UNIVERSITY AND EDUCATIONAL NEWS

DR. DAVID P. BARROWS, professor of education and later of political science in the University of California, at one time director of education for the Philippine Islands and author of works on the islands, has been elected president of the University of California, to succeed Dr. Benjamin Ide Wheeler.

DR. HORACE G. BYERS, formerly of the University of Washington, who was recently appointed chemist in charge of soil investigations in the Bureau of Soils, has accepted the position of head of the department of chemistry at Cooper Union Institute, New York City.

DR. WALTER H. EDDY, who during the war was a major in the Sanitary Corps and served first as assistant director and later as director of the food and nutrition department of the A. E. F., has been appointed a member of the faculty of practical arts of Teachers College, Columbia University, in charge of physiological chemistry.

Dr. Ernest William Goodpasture has been appointed assistant professor of pathology at the Harvard Medical School.

Mr. R. S. Troup, assistant inspector-general of forests, India, has been elected professor of forestry at Oxford.

At the University of Lyons, Dr. Mouriquand has been appointed professor of general pathology and therapeutics in place of Professor Lesieur, deceased, and Dr. Policard has been appointed professor of general anatomy and histology in place of Professor Renaut, who has retired from active service.

DISCUSSION AND CORRESPONDENCE

AN UNUSUAL FORM OF RAINBOW

The following is an account of a rainbow which, although probably simple enough in theory, was entirely new to the writer and seems to be worthy of record. The refracting spheres were neither falling raindrops nor drops suspended in air. They were drops resting on the surface of a lake but kept from breaking through the lake surface by a surface tension effect. They probably resulted from a fog which had hung over the lake during the night and persisted longer than usual after sunrise. The morning was unusually calm, and no ripples had yet appeared on the lake. The floating drops gave the surface an appearance like that caused by a scum, but close examination showed the individual drops quite distinctly and also showed that the light of the bow undoubtedly came from them, for part of the bow came quite close to the observer.

The bow was seen about nine o'clock according to the daylight-saving bill, or eight by the usual local railroad time. Its appearance was about as shown in the accompanying figure. *AB* is the western shore-line of the lake, about 200 yards away. The bow was complete except in the following particulars: the part near *S* was hidden by the shadow of the observer and that of the boat in which he sat; and the part *PRQ* was inverted, like a reflection of what should have been the crest, the part near *R* being somewhat less bright than the rest. The ends of this inverted portion seemed to meet the ends of the larger arc at the shore-line, but there is no reason why such an accidental line should determine the intersection of the two

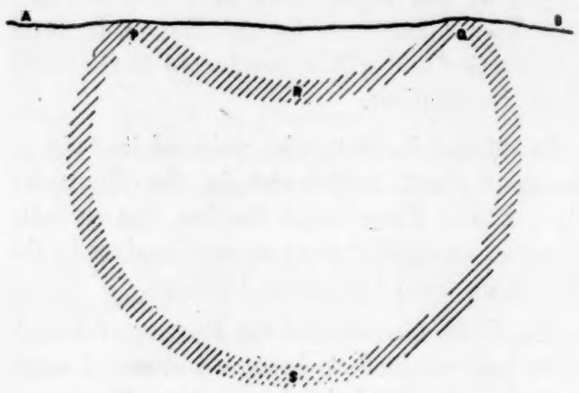

Fig. 1.

branches. Probably they should meet at the horizon. Owing to the closeness of the observer's eye to the water-level, and the distance of the shore-line, the latter would differ in angular position very slightly from the true horizon. Though the bow was very brilliant, no trace of a second bow was visible.

The obvious explanation of the inverted portion is that it is formed by reflection in the lake surface, either directly before or directly after the light passes through the drop. If the light enters the top of the drop and is afterward reflected from the lake-surface, the reflected ray will clear the drop if the elevation of the sun is greater than 21°.6. If it is first reflected from the lake and then enters the drop at the angle of incidence proper to give rise to minimum deviation, the sun's elevation must be less than 20°.4 in order for the incident ray to clear the drop. These figures are calculated on the assumptions that the drop is spherical, that it rests on the surface, and that the angle of the bow is that given by the elementary rainbow theory.

H. M. Reese

University of Missouri

A SIMPLE DEVICE FOR ILLUSTRATING OSMOSIS

The difficulty of preparing a "leak-proof" apparatus to demonstrate osmosis by the use of parchment and thistle tube, led me, last

year, to experiment with other animal membranes. As a result I found that the method outlined below proved uniformly satisfactory.

The skin of a freshly killed or of a preserved frog was cut at the junction of leg and trunk. This cut, entirely encircling the leg, permitted the skin of the leg to be peeled off precisely as a glove is removed from the hand. At the knee joint it was necessary to proceed carefully to avoid tearing the skin. Having pulled the skin off as far as the foot, the bones and sinews were cut. The result was a leg-shaped sac, open at the top, containing the bones of the foot at its lower end, and entirely free from perforations. The sac was pulled over the end of a glass tube about twelve inches long, and securely fastened by several turns of strong thread. A strong solution of dextrose was poured into the open end of the tube, and the tube shaken until the liquid passed, drop by drop, down into the sac. This process was continued until the liquid stood about an inch high in the tube. The apparatus was supported in such a way that the sac of skin was completely immersed in a tumbler of water. The level of the liquid was recorded by putting a small label on the tube, and the apparatus was ready for demonstration.

The apparatus and procedure described above have the following advantages over any other method that I have seen:

1. *Simplicity.*—Parts are to be found in any biological laboratory. Entire apparatus can be set up in fifteen minutes.

2. *Reliability.*—It is a very simple matter to secure a water-tight junction of the sac and tube by taking several turns of thread and tying the sac tightly to the tube.

3. *Rapidity of Action.*—Since there is a large surface exposed to osmotic action, the rise of the liquid in the tube is rapid. It is not uncommon to note a rise of one centimeter in twenty minutes. This is a valuable point, for it makes possible the recording of data and results in the same laboratory period. A narrow label may be fastened to the tube to mark the level of the liquid at the beginning of the hour. The data are given the pupil, a sketch of the apparatus is made, and by that time the liquid has risen enough to make possible the recording of the new level and the drawing of conclusions. After the contents of the tumbler have been tested with Fehling's solution, pure water may be substituted, and the experiment repeated.

ELBERT C. COLE
HARTFORD PUBLIC HIGH SCHOOL,
HARTFORD, CONN.

WHY NOT GOVERNMENT-MAINTAINED FELLOWSHIPS?

IN recent number of SCIENCE,[1] Mr. E. W. Nelson has called attention to the many opportunities that exist in Washington for research in connection with the various government bureaus. To the end that these opportunities may be more widely appreciated he suggests a closer cooperation between the universities and these bureaus and he suggests that universities might find it possible to maintain fellowships which would permit their holders to work at Washington.

That such opportunities exist is undeniable and there are doubtless a very large number of workers who would be extremely glad to take advantage of them, but that any university will be able to establish even a single fellowship of this type is almost too much to hope for. The number of fellowships of even the ordinary character is still far too few. However, there is another angle from which the matter may be approached.

Why should not the federal government itself maintain a group of such fellowships? The presence in Washington of the Congressional Library, the National Museum and the various government bureaus has at times been used as an argument in favor of the establishment there of a National University. Whether such a university should be established is perhaps debatable and whether if it were established it could effectively utilize these special opportunities is more so. In fact it probably could not. But in the absence of such an institution, or perhaps even in addition to it,

[1] Nelson, E. W., "Cooperation between Zoological Laboratories and the Government Bureaus," SCIENCE, XLIX., 409, 1919.

these splendid opportunities might well be made available for the holders of such fellowships as I have suggested.

These fellowships should not be restricted to the purely scientific branches. What better place than Washington for historical research? Where else than in the Department of Labor with such a division as the Children's Bureau could certain social problems be studied to better advantage? Yet it is probable that the majority of such fellowships would be in connection with the scientific activities of the government. For that reason it is from our national scientific societies that the initial impulse for a movement leading to the establishment of such an institution must come.

G. F. Ferris

SPECIAL ARTICLES

THE TERM "INVERSION"

The diversity among the phenomena which are referred to by the term "inversion" is so great that at present the word has lost any precise meaning which it may have had in the past. The organic chemist uses it when discussing the behavior of the allotropic forms of a substance and also when alluding to that well-known single-phase phenomenon, the inversion of cane sugar; while the inorganic chemist generously uses it to denote, in addition to the meanings already referred to, such a phenomenon as an incongruent melting. The writer is not an organic chemist and therefore does not wish to criticize the terminology used by the organic chemists, but feels in duty bound to protest against the present use of the term "inversion" by most inorganic chemists.

When an inorganic chemist hears the term "inversion" used, he invariably associates it with phenomena like the change of rhombic to monoclinic sulfur[1] or phenomena like the thermal dehydration of sodium sulfate decahydrate.[2] The first use of the term is, I think, a very satisfactory one, but for the second type of phenomena a different term should be employed, since otherwise there can not but result an overlooking of the important temperature interval which characterizes this type of "inversion" in systems of three or more components. The term "transition," now used synonymously with "inversion," could well be confined to phenomena of the second class mentioned above.

The distinctive feature about an inversion such as that of rhombic to monoclinic sulfur is the fact that the inversion temperature is a fixed point[3] at constant pressure regardless of the complexity of the system, provided no solid solutions are formed, whereas in the case of the transition of sodium sulfate decahydrate to the anhydrous salt the transition temperature is dependent, in addition, upon the composition of the whole system. Thus both hydrated and anhydrous salt can coexist in the presence of suitable liquids over a wide range of temperatures. The change of transition temperature by the addition of a third component is not an isolated phenomenon but rather an example of one of the types met with most frequently in phase rule studies of complex systems.

On the theoretical side Bancroft[4] has pointed out as a corollary of the theorem of Van Alkemade[5] that in ternary systems at constant pressure involving no solid solution the temperatures at which two solid phases can coexist in the presence of a suitable liquid will rise as the composition of the liquid approaches the side line, *i. e.*, will be a maximum in the binary system. In other words, in a system such as sodium sulfate: water: sulfuric acid, the temperatures at which the solid phases, sodium sulfate and sodium sulfate decahydrate, can coexist will rise as the liquid becomes less acid and be a maximum when the solution contains no free acid.

With this corollary in mind, the effect of

[1] Findlay, "Phase Rule," page 34 (1908).

[2] *Ibid.*, p. 138.

[3] The variable inversion temperature of cristobalite (SiO_2) found by C. N. Fenner, *Am. J. Sci.*, 36, 331 (1913), is a phenomenon of unstable equilibrium and is hence excluded from this discussion. discussion.

[4] "The Phase Rule," W. D. Bancroft, p. 149 (1897).

[5] *Z. physik. Chem.*, 12, 371 (1893).

adding a component to the systems under discussion may be deduced. In the first case suppose we had both rhombic and monoclinic sulfur coexisting, and suppose, keeping the temperature and pressure constant, we added another component. The total quantity of crystalline sulfur would probably be changed but the crystalline sulfur remaining (if any) would consist of crystals of both the rhombic and monoclinic forms. In the second case suppose we had a saturated solution of sodium sulfate and sodium sulfate decahydrate and, again keeping the temperature and pressure fixed, we added a third component. The sodium sulfate decahydrate would promptly disappear and only a saturated solution of the anhydrous salt, together with anhydrous salt, would be left. This will probably appear clearer after a discussion of the diagram given in Fig. 1.

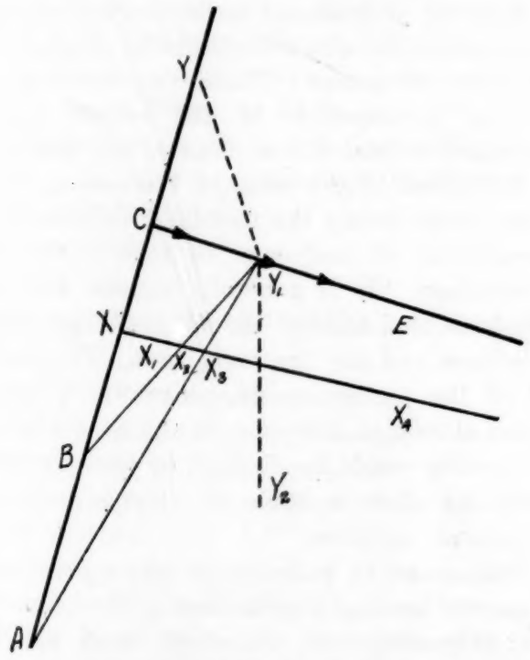

FIG. 1.

Let B in Fig. 1 represent the composition, on one of the side lines of a three-component triangular diagram, of a hydrated salt, and A the composition of the anhydrous form. CE represents the boundary line between the fields of A and B and the temperature falls from C to E as shown by the arrow. Now suppose we take a saturated solution of B in contact with crystals of B, with total composition represented by X and with the composition of the solution represented by Y. The isotherms (saturated solutions of A and B) on the concentration diagram are shown by the lines running from Y to Y_1 to Y_2. If now to X we add the third component the total composition will vary along XX_4. While the total composition varies from X to X_2 the hydrated salt will persist, and while the total composition varies from X_2 to X_3 both salts and the solution Y_1 will be obtained, but when the composition passes X_3 only the anhydrous salt and a solution will be obtained.[6]

Enough has been given, I think, to demonstrate the essential differences in the character of the phenomena under discussion and I would suggest[7] that the term *inversion* be restricted to phenomena like the change of rhombic to monoclinic sulfur, and the term *transition* to phenomena similar in type to the dehydration of sodium sulfate decahydrate, and that in cases in which the composition of all the phases concerned may be represented by simple chemical formulas, the word *dissociation* be employed.

In conclusion I should like to draw attention to a distinction made by Findley[8] between transitions in the solid state and melting point phenomena. He states:

> The transition point, however, differs in so far from a point of fusion, that while it is possible to supercool a liquid, no definite case is known where the solid has been heated above the triple point without passing into the liquid state. Transformation, therefore, is suspended only on one side of the melting point. In the case of two solid phases, however, the transition point can be overstepped in both directions, so that each phase can be obtained in the metastable condition.

This has been interpreted by many to mean that a crystalline substance can not exist even

[6] See Roozeboom, "Die Heterogenen Gleichgewichte," III., part 1, page 190.

[7] Writers like Findlay and W. C. McC. Lewis use the words "transition," "inversion," and "transformation" synonymously, while Bancroft in denoting such phenomena uses the word "inversion" almost exclusively.

[8] "The Phase Rule," p. 37.

momentarily at temperatures above its melting point. Such an interpretation is untrue since this phenomenon has been observed by several investigators[9] with materials such as the minerals quartz and albite, which, while in the process of melting, may exist for some hours at temperatures above their true melting points. Correctly interpreted, Findlay's distinction holds good for cases of true metastable equilibrium, in which no change of phase is in progress, and which are the cases he evidently had in mind.

J. B. Ferguson
Geophysical Laboratory,
Carnegie Institution of Washington,
September, 1919

ORGANIZATION OF THE AMERICAN METEOROLOGICAL SOCIETY

[Objects: The advancement and diffusion of the knowledge of meteorology and climatology; and the broadening of their applications in public health, agriculture, engineering, aeronautics, industry and commerce.]

Since the publication of the original announcement in Science, August 22, 1919, pp. 180–181, several thousand circulars have been distributed among prospective members. Up to December 1, 470 had indicated their desire to join the society when organized. Roughly, the percentage make-up of these is as follows:

1. Weather Bureau	37
2. Cooperative observers of the Weather Bureau	6
3. Army, Navy and other government people professionally interested in meteorology.	8
4. Business men, farmers, engineers and others professionally interested in meteorology	8
5. Teachers and students	16
6. Canada	2
7. Latin America	3
8. Amateur meteorologists (not classed above) includes those formerly engaged in meteorological work	20
Total	100

[9] A. L. Day and E. T. Allen, "The Isomorphism and Thermal Properties of the Feldspars," Publication No. 31 (1905) Carnegie Institution of Washington. J. B. Ferguson and H. E. Merwin, *Am. J. Sci.*, 46, 417 (1918).

Of the whole number 40 per cent. are professional meteorologists. Many have urged strongly that the practical applications of meteorology be emphasized and that special efforts be made to interest engineers, business men, shippers, farmers, fruit growers, aviators and others whose work is closely dependent on the weather. Those who study merely for its scientific interest will have much to gain from association with those who apply meteorology in the conduct of their business. Two leading views expressed concerning the type of organization are:

(1) That the society should be popular in nature in order to get as many as possible interested in the scientific aspects and applications of meteorology and climatology, and in this way to advance the science by united effort and funds to promote research, and (2) that the society should be strictly scientific, and have rigid qualifications for membership, so that the professional meteorologists can by close personal contact cooperate in research to the best advantage. These two views may not be incompatible if the society when organized welcomes as a member any one who is interested in the aims of the society, and elects from among the members, fellows, as a recognition of eminence in meteorology or climatology. It is generally agreed that all members and fellows should have the same privileges and pay the same dues. The council of the society would, naturally, be composed almost of fellows. Thus, the affairs of the society would be directed by its scientists, with the close backing of a large body of interested members.

Dues must be sufficient to pay current expenses of issuing a periodical leaflet of news, notes, queries, etc., but they must not be burdensome for the large group of underpaid government employees and teachers who are interested. If more than 500 members are procured, dues of $1 per year would probably be sufficient. Much has been said in favor of an endowment fund, and, as some have suggested, also library, instrument, scholarship, and building funds. To procure endowment, the society will probably be incoporated

and provisions made for contributing, sustaining and patron memberships.

A preliminary meeting to discuss organization plans and to nominate officers of the American Meteorological Society will be held at the close of the meteorological program of the Philosophical Society of Washington, Saturday evening, December 20. The meeting for organization will take place at Soldan Hill School, St. Louis, December 29, at 2 P.M., and sessions for the presentation of papers will be held December 30 and 31. Joint sessions are being arranged with the American Physical Society and the Association of American Geographers for December 31 or January 1. Plans are being made for a meeting in New York on January 3.

A tentative constitution and by-laws, conforming as far as possible with the numerous and diverse suggestions received, is being drafted, and will be printed about December 10, along with the programs and abstracts of papers to be presented at the St. Louis and New York meetings. These, with details as to hotel accommodations in St. Louis, will be mailed up to December 20 to those who have indicated their desire to join the society.

CHARLES F. BROOKS

WEATHER BUREAU,
WASHINGTON, D. C.

THE AMERICAN CHEMICAL SOCIETY.

V

FERTILIZER DIVISION

F. B. Carpenter, *Chairman*

H. C. Moore, *Secretary*

Injurious effects of borax in fertilizers on crops: B. W. KILGORE.

The conservation of nitrate of soda in the chamber process for the manufacture of sulfuric acid: ANDREW M. FAIRLIE. In connection with the prevalent protest against the high cost of food, means for conserving nitrate of soda in the manufacture of sulfuric acid has a two-fold interest: (1) The lowest possible consumption of nitrate of soda in the manufacture of sulfuric acid means low cost for producing the acid, and, as sulfuric acid is a principal item in the cost of making acid phosphate, cheaper sulfuric acid should result in cheaper phosphate, and cheaper phosphate, in cheaper food. (2) Nitrate of soda is itself an important ingredient of fertilizer, and any decrease in the consumation of nitrate for making acid should react in favor of a decreased demand, and so of a lower price, for nitrate of soda. The various methods of introducing nitrogen compounds into the acid-making process are reviewed, and the methods in common use for controlling the chamber process are briefly described. Attention is directed to the gradual extension of the analytical method for chamber-process control, and to the improved results attained where this method has been adopted. The Gay-Lussac tower, as a means of recovering the nitrogen compounds, is not yet an ideal, nor yet an efficient, piece of apparatus, and the need exists for either (1) an improved type of Gay-Lussac tower; (2) an auxiliary to the Gay-Lussac tower; or (3) a substitute for that tower, capable of effecting a higher percentage of niter recovery.

Check meal work of the Society of Cotton Products Analysts (in particular reference to the moisture and ammonia determinations: F. N. SMALLEY.

The Deroode-perchloric acid method for determining potash: T. E. KEITT.

A rapid and accurate method for determining nitrogen in nitrate of soda by the Devarda method, and the use of the Davission scrubber bulb: C. A. BUTT. A rapid and reliable method for determining nitrogen in nitrate of soda, suitable for routine analysis, consists of reduction of the nitric nitrogen to ammonia by the use of 3 grams Devarda's Alloy, 20 mesh, in a solution of 300 c.c. volume containing 3–5 c.c. sodium hydroxide 45° Be. The distillation of the ammonia is carried out synchronously with the reduction, using the regular Kjeldahl apparatus fitted with the Davisson type of scrubber, which prevents alkali mist reaching the receiving flask. An aliquot of the nitrate solution, corresponding to .8517 grams sample, is used and the ammonia collected in $N/2H_2SO_4$. Titrations are made in the usual way, using methyl red indicator. Results are reported showing accuracy of method.

The rapid and accurate determination of nitrate, as ammonia, in nitrate of soda by a modification of the Kjeldahl-Gunning method vs. the deceptive west coast or refraction method. Correct and rapid application of the modified Kjeldahl-Gunning method to mixed fertilizers containing nitrate: H. C. MOORE. The author compares the various methods in common use for analysis of nitrate of soda,

referring to the relative convenience of these methods for fertilizer chemists. Also points out again that the West Coast method is deceptive and recommends that it be eliminated from contracts governing transfers of commercial nitrate of soda. Also shows development of a modification of the Kjeldahl-Gunning (sulfuric-salicylic) method for the rapid and accurate determination of nitrate, as ammonia, also indicates errors in this method as sometimes used. Also shows correct application of the method to mixed fertilizer containing nitrate.

The caking of sulphate of ammonia: C. G. Atwater and Dr. J. F. W. Schultz. Sulphate of ammonia, even when dried and screened to fit it for fertilizer use by itself as a top dressing, has shown a tendency to cake in certain cases. Examination of the material that had given trouble finally indicated in this case that the trouble was due to the presence of salts of pyridine bases which are deposited with the salt in the saturator. These impurities give the salt a slightly sticky nature; cause absorption of water and caking. By passing dry ammonia gas through the sulphate to neutralization, the pyridine was set free and the objectionable characteristics removed.

The caking of sulfate of ammonia and acid phosphate mixtures: C. G. Atwater and J. F. W. Schnultz.

The American potash industry: R. O. E. Davis. Domestic production of potash grew from 1,000 tons in 1915 to 9,000 in 1916, 32,000 in 1917, and 55,000 in 1918. At the close of 1918 there was a potash-producing capacity in this country of approximately 100,000 tons per annum. The sources of potash are widespread, covering about sixteen states in various sections of the Union. The main production has come from Nebraska and California. Fourteen cement plants have installed methods of collecting potash from flue dust. Two blast furnaces have similar methods in operation. Five molasses distilleries are recovering potash from their wastes. A number of beet sugar refineries recovered small amounts of potash. The Green sands of New Jersey are a source of potash for two plants. One plant is utilizing Georgia shale as a source of potash. One plant at Marysvale, Utah, is utilizing alunite, and kelp formed the basis of operation for four large companies on the Pacific coast. Other minor sources exist, such as wood ashes, wool washings, and the brines of the great Salt Lake basin. The best prospects for the development of a permanent industry in competition with foreign potash appears to be from the gradual solving of technical details of processes where potash can be obtained in localities near consumption centers and in the development of by-products. Western producers must meet the handicap of high freight rates to eastern markets, although the development of by-products and improved methods may overcome this handicap.

The relative availability of nitrate nitrogen and commercial organic nitrogen—field and cylinder experiments: A. W. Blair. For more than 20 years, the New Jersey Experiment Station has been studying by means of field and cylinder experiments, the relative availability of nitrate nitrogen from organic sources. The work has been conducted on two types of loam soil and also on a loam with varying admixtures of coarse white sand to represent soils varying in texture. For all of these soils, except those containing 80 per cent. or more of sand, the nitrates have stood first in yield of dry matter and percentage of nitrogen recovered in the crop. Under the most favorable conditions, only a little over 60 per cent. of the applied nitrogen can be recovered in the crop. Under less favorable conditions, the percentage recovery is much lower, often amounting to only one third of the amount applied. The average recovery of nitrate nitrogen in the field experiments was 37 per cent. and of organic nitrogen 26½ per cent. It is suggested that the reason for the larger return from nitrate nitrogen than from organic nitrogen may be found in the immediate availability of the former. The plant is thus given a good start and on account of the rapid growth which it makes, it is able to utilize the nitrogen more fully than the plant which must wait for a supply of available nitrogen, until the organic matter has gone through the process of decomposition.

Charles L. Parsons,
Secretary

(*To be continued*)

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